



Project Abstract

Enabling the Study of Long-Term Human and Social Dynamics: A Cyberinfrastructure for Archaeology

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Scientific investigations of social and socio-environmental systems are seriously impaired by a lack of millennial- or centennial-scale data. In developing and testing explanatory models, we must do more than project recent observations—reflecting at most a few decades—into the past or future. Archaeology can provide the long-term data on societies and environments needed to illuminate such critical topics as demography, economy, and social stability. To date, efforts to recognize phenomena operating on large spatio-temporal scales have been crippled by the inherent complexities of archaeological data, the lack of data comparability across projects, and limited access to primary data. Nonetheless, the potential for archaeological insights to contribute to the study of long-term social dynamics is enormous; the fundamental challenge is to enable *scientifically meaningful* use of an expanding corpus of data.

Project Objectives

Goal 1: To develop a shared vision for a cyberinfrastructure of archaeology, to assess the major sociological, archaeological, and information technology challenges that must be confronted, and to outline for a long-term strategy for achieving that vision. This goal was attacked through a December 2004 workshop including 31 individuals representing diverse archaeological interests, computer scientists concerned with information integration and informatics, and scientists associated with informatics infrastructure projects ongoing in other disciplines. The workshop focused on the needs for information integration in archaeology and was hosted by the National Center for Ecological Analysis and Synthesis (NCEAS).

Goal 2: To develop a base ontology and schema for a limited segment of an archaeological data domain, to use that ontology to develop metadata for a modest variety of sample data sets; and to illustrate the flexibility and utility of this approach. This has been accomplished by a smaller working group of faunal analysts working intensively with project computer scientists on a concrete problem with actual data. The Faunal Working Group met once in the Fall of 2004 and will meet again early in 2006; initially to refine the problem and outline key ontology and metadata issues, and second to discuss and evaluate the application deriving from the first meeting.

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Progress & Preliminary Outcomes

A workshop entitled [The Promise and Challenge of Archaeological Data Integration](#) was held in Santa Barbara, California in December of 2004. The report of the workshop concluded that new technologies in information integration will enable archaeologists to:

- work at scales not currently possible to answer pressing questions that cannot now be addressed due to a lack of effective access to existing data;
- foster the development of a new paradigm of integrative and synthetic research;
- scale and integrate archaeological data so that they can be used to address compelling questions in other disciplines; and
- sustain the scientific utility of existing digital data that are critically endangered by media degradation, software obsolescence, and inadequate data documentation (metadata).

The workshop concluded that to meet pressing research needs and to help stem the loss of existing information, it is essential that we embark now on the task of creating an infrastructure that will allow us to archive and make available integrated databases of archaeological data.

Our intensive investigation of the information integration demands of archaeology has led both to a clear definition of the computer science challenges posed by a cyberinfrastructure for archaeology and the design of a technical approach that accommodates the unusual demands of the domain of archaeology. We conclude that these technical challenges cannot be met by a straightforward adaptation of existing information integration technologies. Needed are tools employing novel query-driven, ad hoc data integration techniques that allow archaeologists to register their data sets, and integrate them with already registered data sources to enable complex inferences. Such an architecture will allow researchers to extract a sensibly integrated and appropriately scaled database of analytically comparable observations from multiple datasets gathered using incommensurate recording protocols.

We are now refining a prototype application that we developed that implements the ad-hoc integration strategy for a limited problem domain relevant to an intellectual challenge posed by the faunal working group. This development was accomplished through close collaboration of project archaeologists and computer scientists and a team effort by one graduate research assistant in computer science and another in archaeology.

Broader Impacts

Such an information infrastructure will enable researchers across scientific disciplines to substantially advance complex socio-ecological modeling efforts and to address large-scale and long-term questions with empirical support that has heretofore been unthinkable. Impacts extend far beyond the traditional boundaries of academia including critical needs of private, tribal and governmental archaeology programs. It provides a means to maintain the long-term utility and accessibility of irreplaceable primary data in the face inadequate metadata and rapidly changing technology.



The information integration architecture we have designed will have broad applicability in other science-informatics domains in which complex inferences need to be made over multiple heterogeneous, inconsistent, and context dependent sources. Specialists in other fields will gain direct access to intermediate-level archaeological knowledge as well as to primary data that are scaled and reconciled to match the scope of their inquiries. By providing scholars in diverse fields with meaningful access to long-term data on society, population, and environment, archaeology can help explain the complex human and social dynamics that have constituted today's social world and have shaped the modern environment.

Project Website

<http://cadi.asu.edu>